(a) detecting a temperature difference across the catalyst;

(b) comparing the temperature difference with a predetermined temperature threshold;

(c) determining a temperature at an output of the catalyst when the temperature difference is determined to exceed the threshold.

REMARKS

Reconsideration and re-examination are hereby requested.

Applicant hereby amends claim 1 and adds additional claims 12 and 13.

Claim 1 has been amended to more clearly define "light-off event". More particularly, claim 1 points out that "such light-off event being detected when there is a hydrocarbon-oxygen reaction wherein an exothermic reaction is produced and detected."

It is pointed out that this submission provides additional arguments which arise from positions taken by the Examiner for the first time in the Examiner's reply brief.

This RCE is being filed in order for the additional arguments presented below to be fully considered by re-opening patent prosecution. It is noted that these additional arguments supplement and do not replace the arguments previous made during the previous prosecution,

The Examiner stated on page 9 of the Examiner's Answer, a position for the first time.

> Regarding the base claim 1, in response to appellant's argument that King et al. fail to disclose injecting the hydrocarbons into the engine exhaust in accordance with detection of a light-off event (page 10 of Appellant's Appeal Brief), the examiner respectfully disagrees.
>
> As discussed in the brief background of King et al., they only inject hydrocarbons when the catalytic converter is inside its prime operating mode (lines 25-30 of column 3). Only in this prime operating mode, the injected hydrocarbons can be made to react with the NOx in the exhaust gas in a sufficient scale such that no excess hydrocarbons are inadvertently released to the atmosphere. Also in this mode, the hydrocarbons are also oxidized to release large quantity of heat to raise an exhaust gas temperature. This is why the downstream temperature sensor can detect a higher temperature at the outlet of the catalytic converter than that at the inlet when the catalytic converter is inside its prime operating mode. The examiner hereby argues that the light-off event in a catalytic converter that appellant is referring to is the

> onset event of the prime operating mode in King et al. (emphasis added). In this context, the prime operating mode in King et al. can be seen as a number of events of which each displays a different NOx purification efficiency. The very first event or the onset event in this operating mode displays a threshold NOx purification efficiency that is sufficient for hydrocarbons to be injected to assist in the purification of the exhaust gas. The examiner again urges that this very first event in King et al. is indeed the light-off event as claimed in claim 1 of the pending application.

Applicant first wishes to point out that the reaction between hydrocarbon (HC) and NOx is ~~isothermic~~ endothermic (as distinguished from an exothermic reaction), while the reaction between HC and oxygen is exothermic. The former reaction is what defines the "prime operating mode" of the catalyst, the latter reaction generates the exotherm, that is used in our invention to adjust the temperature over which reductant is injected. Referring to FIG. 4 of the patent application, the catalytic converter enters its prime operating mode when the NOx conversion efficiency, indicated by the curve with the squares, is greater than zero.

In the example shown in FIG. 4 this occurs at temperatures between 150 and 400 deg C. On the other hand, the burning, or oxidation, of the HC, i.e., "fraction of HC burned ", shown by the curve with the diamonds has a window from 180 degrees and above. In the example shown in FIG. 4, the light-off event thus occurs at a temperature after the catalytic converter enters its prime operating mode. Conversely, reductant is injected ***before*** the catalyst generates an exotherm.

There is thus a fundamental difference between occurrence of an exotherm and the prime operating mode of the catalyst (NOx conversion), and the former is ***not*** the onset of the latter.

The examiner takes the position that King et al. only injects HC when the catalyst is inside its prime operating mode. Thus, here in FIG. 4 this would be at temperatures between 150 and 300 deg C.

However, Applicant adjusts this window based on the detection of the light-off event, i.e., here at a temperature of 180 degrees C. That is, when the catalytic converter reaches the light off event temperature which is not the same as the temperature at which the catalytic

convert enters its prime operating mode

Further, Hirota's T2 is not a detected "exothermic condition". That is, t***the temperature T2 of Hirota et al is NOT the output temperature of the catalyst BUT RATHER THE UPPER LIMIT OF A TEMPERATURE RANGE. See col. 5, lines 26-28,*** as fully discussed in the prosecution below.

Consider two premises. A first premise is that T2 is an upper temperature limit (as also stated by the examiner, p11, l3), not an exothermic condition. A second premise, as stated by the Examiner' s Answer on Page 10, line 3 from bottom i.e., that T2 is an exothermic condition temperature. The two premises combined imply that T2 is the upper limit of the temperature window over which an exotherm occurs. However, the exothermic reaction has no upper temperature limit: i.e., hydrocarbons will continue to be oxidized, once above light-off, regardless of how high the temperature.

Since the conclusion is false, one of the premises must be false. Applicant and the Examiner agree that premise 1 is correct. Therefore, the second must be false.

Applicant also wishes to point out an oversight. The examiner has stated in the Examiner's answer that all claims rise and fall together. First, it is noted that each Group has only one claim. Reference is made to 37 CFR 1.192 (c)(7):

> (7) *Grouping of Claims.* For each ground of rejection which appellant contests and which applies to a ***group of two or more claims***, the Board shall select a single claim ***from the group*** and shall decide the appeal as to the ground of rejection on the basis of that claim alone, unless a statement is included that the claims of the group do not stand or fall together and, in the argument section of the brief, appellant explains why ***the claims of the group*** are believed to be separately patentable (emphasis ours).

Further, paragraph (7) of the Brief stated:

(7) Grouping of claims

Group I -Claim 1
Group II- Claim 4.
Group III- Claim 5
Group IV- Claim 6
Group V -Claim 7

Group VI- Claim 8
Group VII- Claim 9
Group VIII- Claim 10
Group IX- Claim 11.

The claims in Groups I through IX do not rise or fall together.

(Emphasis ours)

It should be noted that the Applicant has provided arguments for each Group and therefore each one of the pending claims.

Applicant submits that all of the claims are now in condition for allowance, which action is requested.

Any questions regarding this matter may be directed to the undersigned. In the event any additional fee is required, please charge such amount to the Patent and Trademark Office Deposit Account No. 50-0845.

Respectfully submitted,

3-27-03
Date

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COMPARISON OF CHANGES TO CLAIMS

2. (Amended) A method for controlling hydrocarbon injection into an engine exhaust to reduce NOx, comprising:

injecting the hydrocarbon into the engine exhaust in accordance with detection of a light-off event, such light-off event being detected when there is a hydrocarbon-oxygen reaction wherein an exothermic reaction is produced and detected.

4. A method for controlling hydrocarbon injection into an engine exhaust to reduce NOx in such exhaust, such engine exhaust with the NOx and the injected hydrocarbon being directed to a catalyst for reaction therein, comprising:

(a) detecting an exothermic reaction across the catalyst; and

(b) detecting a temperature of an output of the catalyst in response to the detected exothermic reaction; and

(c) injecting the hydrocarbon into the reaction in accordance with the detected temperature.

5. A method for controlling hydrocarbon injection into an engine exhaust to reduce NOx in such exhaust, such engine exhaust with the NOx and the injected hydrocarbon being directed to a catalyst for reaction therein, comprising:

(a) detecting a temperature difference across the catalyst;

(b) comparing the temperature difference with a predetermined temperature threshold;

(c) determining an exothermic condition temperature at an output of the catalyst when the temperature difference is determined to exceed the threshold;

(d) comparing the determined exothermic condition temperature with an exothermic condition temperature expected from the catalyst at a time prior to the determined exothermic condition temperature; and

(e) modifying the injected hydrocarbon in accordance with said last-mentioned comparison.

6. A method for determining peak efficiency temperature of a catalyst in reducing NOx wherein such NOx is reduced by reacting such NOx in the catalyst with a hydrocarbon, comprising:

(a) detecting a temperature difference across the catalyst;

(b) comparing the temperature difference with a predetermined temperature threshold;

(c) determining an exothermic condition temperature at an output of the catalyst when the temperature difference is determined to exceed the threshold.

7. A system for controlling hydrocarbon injection into an engine exhaust to reduce NOx in such exhaust, such engine exhaust with the NOx and the injected hydrocarbon being directed to a catalyst for reaction therein, comprising:

(a) a catalyst for facilitating a reaction between the injected hydrocarbon and NO_x in the exhaust;

(b) a hydrocarbon injector for injecting the hydrocarbon into the exhaust upstream of the catalyst;

(c) a detecting system comprising:

a pair of sensors each detecting a common parameter in the exhaust, one of such sensors being upstream of the catalyst and the other one of the sensors being downstream of the first sensor; and

a processor for controlling the hydrocarbon injector in response to the pair of sensors, such processor being programmed to:

compare a difference in the common parameter detected by the pair of sensors with a predetermined threshold;

determine an exothermic condition at an output of the catalyst when the difference in the common parameter is determined to exceed the threshold;

ompare the determined exothermic condition with an exothermic condition expected from the catalyst at a time prior to the determined exothermic condition; and

modify the injected hydrocarbon in accordance with said last-mentioned comparison.

9. The system recited in claim 7 wherein the common parameter is temperature and wherein the sensors are temperature sensors.

9. A processor for controlling hydrocarbon injection into an engine exhaust to reduce NOx in such exhaust, such engine exhaust with the NOx and the injected hydrocarbon being directed to a catalyst to facilitate reaction between the injected hydrocarbon and the exhaust NOx, such processor being programmed to:
provide a control signal to a hydrocarbon injector to inject the hydrocarbon into the exhaust upstream in response to output signal from a pair of sensors, each of the pair of sensors being adapted detecting a common parameter in the exhaust, one of such sensors being upstream of the catalyst and the other one of the sensors being downstream of the first sensor, such control signal being provided by steps comprising:

comparing a difference in the common parameter detected by the pair of sensors with a predetermined threshold;

determining an exothermic condition at an output of the catalyst when the difference in the common parameter is determined to exceed the threshold;

comparing the determined exothermic condition with an exothermic condition expected from the catalyst at a time prior to the determined exothermic condition; and

modifying the injected hydrocarbon in accordance with said last-mentioned comparing.

10. A method for controlling hydrocarbon injection into an engine exhaust to reduce NOx in such exhaust, such engine exhaust with the NOx and the injected hydrocarbon being directed to a catalyst for reaction therein, comprising:

comparing a difference in a common parameter detected by a pair of sensors with a predetermined threshold, one of such sensors being upstream of the catalyst and the other one of the sensors being downstream of the first sensor;

determining an exothermic condition at an output of the catalyst when the difference in the common parameter is determined to exceed the threshold;

comparing the determined exothermic condition with an exothermic condition expected from the catalyst at a time prior to the determined exothermic condition; and

modifying the injected hydrocarbon in accordance with said last-mentioned comparison.

11. The method recited in claim 10 wherein the common parameter is temperature and wherein the sensors are temperature sensors.

12. (NEW) . A method for controlling hydrocarbon injection into an engine exhaust to reduce NOx in such exhaust, such engine exhaust with the NOx and the injected hydrocarbon being directed to a catalyst for reaction therein, comprising:

(a) detecting an exothermic reaction across the catalyst; and

(b) measuring a temperature of an output of the catalyst in response to the detected exothermic reaction; and

(c) injecting the hydrocarbon into the reaction in accordance with the detected temperature.

13. (NEW) A method for determining peak efficiency temperature of a catalyst in reducing NOx wherein such NOx is reduced by reacting such NOx in the catalyst with a hydrocarbon, comprising:

(a) detecting a temperature difference across the catalyst;

(b) comparing the temperature difference with a predetermined temperature threshold;

(c) determining a temperature at an output of the catalyst when the temperature difference is determined to exceed the threshold.